Sewage disposal is addressed with on-site septic tank and leach fields systems (see Section 3.11 Public Services and Utilities).

3.6.4 Groundwater Quality

Groundwater quality at the site has been the subject of studies conducted in 1982, 1989, 1992, and 1993. Samples analyzed in association with these studies indicated that most standards were not exceeded. Water quality analyses conducted in 1982 indicated that the water drawn from well WS1 displayed elevated iron concentration. Although the iron content of the water was approximately three times greater than the State-defined maximum contaminant level (MCL) of 0.3 mg/l, the MCL for iron is determined for visual clarity. There were no adverse impacts to human health resulting from the measured iron concentration level.

Water quality data collected from the 1989-sampling event indicated that some organic compounds, including benzene, toluene, 1,2,4-trimethylbenzene, and xylene, were present, but not in quantities that exceeded State criteria. Trihalomethanes, including chloroform, bromoform, dibromochloro-methane, and bromodichloromethane were also detected. The concentration of chloroform exceeded National Primary Drinking Water Regulation standards; however, chloroform and the other trihalomethanes are common byproducts of water chlorination.

The 1992 study sampled shallow groundwater beneath the NWTC to quantitatively define water quality. Analysis of the results of the study indicated that groundwater quality at the NWTC reflects naturally occurring conditions. Although the concentrations of some metals were elevated, the study concluded the concentrations could be attributed to naturally occurring conditions or well installation operations (Woodward-Clyde, 1992).

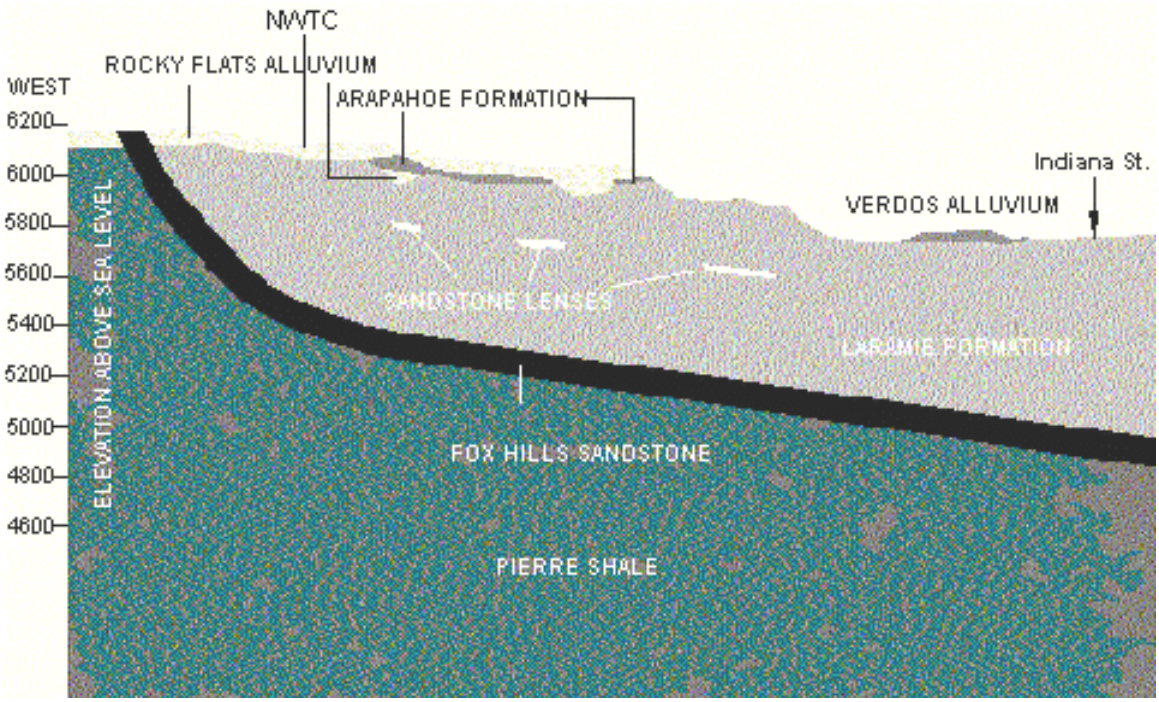
3.7 GEOLOGY AND SOILS

3.7.1 Geology

The NWTC is located on the gently sloping terrain of Rocky Mountain Front Range between the Southern Rocky Mountain Province to the west and Great Plains Province to the east. The Front Range trends north south at elevations of approximately 9,800 feet (2,969 meters), with elevations increasing to 13,000 feet (3,939 meters) along the Continental Divide, approximately 16 miles (25.8 kilometers) west of the site. The elevation of the NWTC is approximately 6,000 feet above sea level. The site area consists of a broad, eastward sloping pediment surface developed on coalescing alluvial fans at the mouth of Eldorado Canyon. The NWTC site is located on the western edge of the Denver Basin, an asymmetrical, north-south trending syncline with a steeply dipping western limb and a shallowly dipping eastern limb. Bedrock layers underneath the site dip to the east or northeast at 30 to 90 degrees from horizontal. The Denver Basin proper contains more than 9,840 feet (2,982 meters) of Pennsylvanian to Cretaceous sedimentary deposits.

The topography in the immediate vicinity of the site exhibits an approximate 2% slope to the east-northeast. No streams or creeks traverse the NWTC site. A minor drainage occurs near the eastern boundary. Figure 3-3 illustrates the geologic cross section beneath the NWTC site.

Figure 3-3 Geologic Cross Section (West-East) Beneath the NWTC Site



Source: CDPHE web site

Geologic units beneath the NWTC consist of unconsolidated Quaternary age (approximately 3 million years ago to the present time) surficial materials that lie unconformably over the Cretaceous (approximately 144 to 65 million years ago) claystone bedrock of the Laramie Formation. The Laramie Formation is a weak claystone and quartzose sandstone formation that was deposited under shallow marine and swamp conditions and is composed of two members. The upper member of the Laramie Formation consists of horizontally interbedded siltstone, sandstone, and claystone layers ranging from 300 to 550 feet (90.9 to 166.6 meters) thick. The lower member is composed of sandstone layers containing coal seams and is approximately 250 feet (75.8 meters) thick beneath the NWTC site. The Rocky Flats Alluvium dominates the surface of the NWTC and consists of unconsolidated surficial materials. The Rocky Flats Alluvium is a pediment/fan deposit composed of dense, poorly stratified clayey gravels and cobbles with some interbedded hard clays and clayey sands. The alluvium-bedrock contact occurs at approximately 40 feet (12.1 meters) below the surface at the NWTC.

The NWTC is located in a Jefferson County "Designated Dipping Bedrock Area," where steeply dipping beds of expansive claystone bedrock are found near the ground surface. When exposed to water, layers of bedrock display different potentials for expansion, resulting in damage to roads and lightly loaded structures. Natural alluvial deposits may reduce the heaving potential of the bedrock at the site. Landslides and other mass earth movements can be present as shallow features where slopes are steep; however, because the slope of the surface at the site averages about 2%, landslides are not characteristic of the site.

The NWTC is located in the Great Plains Tectonic Province. There are several faults in the vicinity of the NWTC, but no faults have been identified under the site itself. The Precambrian-

age Golden and Livingston Faults and Idaho Springs-Ralston Shear Zone are northwest-trending faults located to the west of the NWTC. The Golden Fault separates the Front Range to the west from the Denver Basin to the east. Northeast-trending faults have been mapped north of the site in the Marshall-Superior-Louisville area. The northwest-trending Eggleston fault lies approximately one mile east of the site's northeast corner. Historically, the region has not been very seismically active.

The greatest amount of recent earthquake activity occurred as a result of deep injection of fluid at the Rocky Mountain Arsenal near Commerce City. Approximately 1,800 earthquakes occurred between 1962 and 1972 as a result of the injection, with a maximum magnitude event of 5.2 on the Richter Scale occurring in 1967 after injection was discontinued. The most recent naturally occurring seismic event took place in 1882, with the epicenter located approximately 13 miles (21 kilometers) east of the NWTC (National Wind Technology Center Sitewide Environmental Assessment, November 1996). Faults in the region surrounding the site have a 30 to 40% probability of being seismogenic (Rocky Flats Environmental Technology Site Geotechnical Investigation Report for Operable Unit No. 5, 1995).

3.7.2 Mineral Resources

Mineral resources in the immediate vicinity of the NWTC include sand and gravel, clay, rock for concrete aggregate and riprap, and coal. DOE owns surface rights at the site. Mineral rights are owned by private entities. The mineral rights for the western 160 acres of the site are owned by Rocky Mountain Fuel and apply to the extraction of coal, shale, oil, and natural gas. The mineral rights for the eastern 145 acres of the site are owned by the Spicer family, currently leased by Mineral Reserves, Inc. as successor in interest to Western Aggregates, Inc., and apply to the extraction of aggregate. Active aggregate mining and processing facilities are located to the south and west of the NWTC.

In July 27, 1995, a Utility Right-of-Way Grant of Easement and MOU between Western Aggregates, Inc. and the DOE (i.e., NREL, NWTC) created a 20-year moratorium on mining activities on the eastern 145 acres of the site (see Sections 3.1 and 4.1)

3.7.3 Soils

The soils at the NWTC are derived from surficial formations eroding from the Rocky Mountains during the Quaternary age. At the site, these poor-to-moderately sorted deposits overlie the Laramie Formation. Although a large amount of the soil consists of cobble and gravel, the subsoil that appears approximately between 13 and 47 inches (0.3 to 1.2 meters) below the surface is predominately clay. The permeability of the subsoil is very low, measured at 0.06 to 0.2 inches (0.15 to 0.5 centimeters) per hour. The clay has a moderate shrink-swell potential. Borings taken at Rocky Flats south of the NWTC indicate that groundwater is sometimes perched on top of clay in the alluvium, and that groundwater occurs at depths ranging from approximately 3.5 to 8 feet (1.1 to 2.4 meters) below the surface (Soil and Foundation Investigation, Expansion – Phase 1, NWTC, 1994).

The soils at the NWTC site are dominated by the Flatirons very cobbly sandy loam, which is formed in the noncalcareous, stony to gravely, loamy material of the Rocky Flats Alluvium. The Flatirons very cobbly sandy loam is found on slopes of 0 to 3% and exhibits a low available water capacity. It is used mainly for grazing and wildlife habitat. The Yoder Variant-Midway complex characterizes the hill slopes and ridges located in the west-northwestern areas of the

site. The soils that compose this complex exhibit low water capacity and are used for pasture and wildlife habitat. The Veldkamp-Nederland very cobbly sandy loams are found at the extreme northwestern area of the site. Rock fragments comprise approximately 35 to 75% of this complex. It is primarily used for pasture and wildlife habitat. Soil at the extreme northeastern boundary of the site is known as the Valmont clay loam and is considered to be a "high potential cropland," requiring only irrigation to support agricultural activities. The Valmont is found on slopes ranging from 0 to 3%. It exhibits moderate water capacity and a slight erosion hazard if overgrazed. It is used primarily for crop growth, pasture, and sometimes for community development (U.S. Department of Agriculture, Soil Survey of the Golden Area, Colorado, Soil Conservation Service, 1980). Grazing does not occur within site boundaries, but does occur in some adjacent off-site locations.

Soil samples were taken from the NWTC and analyzed from late 1993 through 1995. The objective of the 1993 sampling program was to define the uncontaminated characteristics of site soil prior to the construction of a leach field. The soils were analyzed for VOCs, petroleum hydrocarbons, PCBs, and radionuclides. Analytical results indicated that detectable quantities did not exceed State of Colorado regulatory limits and were representative of environmental background concentrations (Soil Sampling Program National Wind Technology Center, 1993).

Results of a 1994 geotechnical investigation for facility expansion indicated that the on-site soils are suitable for supporting structures that included new site buildings and turbine foundations. However, foundations could be at risk of heaving caused by wetting and subsequent swelling of the clay portion of the underlying soils (Soil and Foundation Investigation, Expansion – Phase 1, NWTC, 1994).

Additional samples were subsequently taken in 1994 and analyzed in order to develop a more thorough baseline assessment of site soils. The analytical results for the majority of samples were below method detection limits and, therefore, below regulatory thresholds (Report for Reconnaissance Sampling of Soil at NWTC, 1994).

Geotechnical borings were taken and percolation tests were conducted in 1995 to determine subsurface conditions at the site in preparation for construction. The results indicated that subsurface soils at the site exhibited variable swell potentials that could be compensated for by using specified engineering excavation and construction techniques for foundations (Subsurface Investigation and Engineering Analysis Report NREL NWTC Phase II CDE, 1995).

3.8 BIOLOGICAL RESOURCES

The biological resources of the NWTC are broken down into vegetation, wetlands, rare plant species, and wildlife components. The following subsections detail these resources for the NWTC site. This evaluation primarily relies upon previous reporting and fieldwork by other consultants, both for the NWTC site, and on the adjacent RFETS. An extensive annual survey process provides extensive species lists for the NWTC, RFETS, and surrounding areas (USDOE, RFETS, Annual Vegetation Report and Annual Wildlife Survey Reports).